SCIENCE

NEW SERIES
VOL. XLIX, No. 1267

FRIDAY, APRIL 11, 1919

SINGLE COPIES, 15 CTS.
ANNUAL SUBSCRIPTION, $5.00

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MSS. intended for publication and books, etc., intended for review should be sent to The Editor of Science, Garrison-on-Hudson, N. Y.

THE UNIFICATION OF AMERICAN BOTANY[1]

A GLANCE at the history of botany in America shows that on several occasions special branches of the science have attained prominence, have separated from the parent stock and taken independent root. These offspring are now counted as separate sciences which yield little or no allegiance to the parent stock, and whose devotees no longer call themselves botanists. As examples we may mention bacteriology, forestry and the group of agricultural sciences represented by agronomy and horticulture—all subjects essentially botanical, with large and active corps of workers, but belonging to botany no longer.

This dissociation is undoubtedly the natural result of the growth of botany and the development of its several fields, each of which, as it assumes a position of special importance, develops more or less of autonomy and sometimes independence. Other sciences show the same tendency, and I shall not attempt to decide whether botany shows this trend toward dissociation to an exceptional degree. The questions of immediate importance to us are: What are the causes of this dissociation? Are they still operative? What new developments may be expected? How far can the process go without serious injury to botany in general? Can the tendency be overcome in whole or in part? And if so, how? It is fitting that these questions should receive the serious consideration of all botanists at this time for the future is heavy with possibilities. The changes of reconstruction may prove to be more fundamental than those of war, and the responsibility

[1] Invitation paper before Section G of the American Association for the Advancement of Science, in joint session with the Botanical Society of America and the American Phytopathological Society, Baltimore, December 26, 1918.

for American botany during this period of flux rests upon the botanists themselves.

That the tendency amongst botanists toward dissociation is too strong to be disregarded is shown by an examination of the recent botanical programs of these winter meetings in comparison with those of a few years ago. Formerly all botanists met with Section G of the American Association for the Advancement of Science, and with the Botanical Society of America for the reading of papers on miscellaneous botanical subjects. Now, the plant pathologists, the geneticists and the ecologists have independent societies; the physiologists and systematists have separate sections of the Botanical Society with independent programs; and still other groups of botanists are beginning to request recognition and to urge that special sessions be devoted to their subjects. The grouping of papers according to subject matter and the formation of special programs are made necessary by the rapid increase in the number of papers presented, and doubtless are desirable in every way. The formation of different sections by the Botanical Society of America, and even the launching of independent societies by various groups of botanists, are the natural results of rapidly mounting numbers and of increasing specialization.

There is no question but that the evolution of our winter programs indicates healthy growth, yet we must recognize the lurking danger, for we see here one evidence of the centrifugal tendency amongst botanists. Separate programs denote and foster a concentration of effort along special lines. They are one sign of our inclination to segregate into groups, the special subjects in which we are interested acting as the foci of attraction. This segregation, within proper limits, undoubtedly makes for efficiency, but we must take care that it does not lead to undue slackening of interest in other botanical fields than our own, to loss of perspective and to inability to grasp other points of view. If this occurs we shall have crossed the danger line, ultimate estrangement amongst botanists becomes a mere matter of time, and efficiency will give place to disunion and narrowness. Botanical science could not then be compared with a healthy tree surrounded by vigorous offspring in the shape of subsciences; rather would it be likened to an ancient trunk denuded of many of its most important branches which have struck root for themselves and are now selfishly competing with one another and with the impoverished parent stem.

Our problem then is to preserve the unity of American botany without losing the benefits of specialization. It is the old problem of controlling and directing the vital forces which underlie growth and development that they may make for efficiency and strength rather than for disunion and weakness.

I believe there is one factor more potent than any other in promoting disunion amongst botanists. That factor is not the fundamental scientific importance of a given field of botany, nor the speed of its development. We have seen the rise to importance of one subject after another without witnessing their withdrawal from the botanical hearthstone. It is not the development of a peculiar and highly specialized technique, nor the concentration of interest in a particular group of plants. Neither is it mere number of workers in a given field, nor close affiliation with non-botanical subjects. All these factors contribute to dissociation *within* the ranks of botanists, but do not necessarily lead to rupture of those ranks. Perhaps not all combined are so potent in this respect as is economics. Whenever any branch of botany becomes of especial economic importance its centrifugal tendency is enormously increased. The general public is then interested and becomes instrumental in determining the course of development. There is a new and greatly enlarged staff of workers, many of whom have not received orthodox botanical training. These workers in the new field of applied botany lose the isolation of the pure scientist, and come more closely in touch with the problems of human life. New methods of thought appear and new standards of value arise. While the applied botanist is developing the ideals of service to his fellow men, he often over-emphasizes the importance of his own field, loses his catholic interest in botany in

general, and then gradually withdraws from the fellowship of pure botanists.

But the pure botanist is not without fault, for he too often matches the narrowness of the applied botanist with his own intolerance. I have seen mycologists bored to extinction while pathologists excitedly discussed the effects of a serious outbreak of late blight of potatoes, and only become interested when the discussion turned to the morphology of *Phytophthora infestans*. Surely no science is more closely bound up with human life than the study of plants, which furnish us food and drink, shelter and clothing, and supply so many of our other needs, physical, intellectual and esthetical. Yet botany has appeared to dread the economic taint and has seemingly endeavored to keep its skirts free from the stain of the soil in which plants grow. Certainly she has allowed the applied branches to struggle on without the full benefit of a mother's firm yet tender guidance, and too often has repaid the waywardness of the child with aloofness and neglect.

Separations which have occurred already in the botanical field probably were inevitable, and perhaps were for the best interests of the subjects concerned. But there can be no doubt that further divisions would be disastrous. More than that, at this time when botany should face the future with a united front, we can not permit the forces of disunion to go unchecked and any divergences which now exist amongst us must be abated. Such divergences do exist and if neglected will increase in extent. The immediate danger point is found, I believe, in plant pathology. That pathologists have been growing apart from other botanists there can be no doubt, and I have not yet observed any extensive effort on either side to stay the process. Certain conditions surround plant pathology unlike those pertaining to any other branch of botanical science, and some of these conditions make for disunion. In briefly presenting some of these features for your consideration this afternoon I will speak of pathologists on the one hand and of botanists on the other. This distinction is merely for convenience. Pathologists are botanists still, and it is my earnest hope that they may always remain so.

Plant pathologists constitute the largest single group of botanical workers, and the only large group directly connected with the economic field. The latest printed lists of members show 384 names in the roll of the American Phytopathological Society, and 630 names in that of the Botanical Society of America. One hundred and eighty names are common to both societies, making a total of 834 names on both rolls. Of these 834 names, 384 or 46 per cent. belong to pathologists, or to botanists, largely mycologists, who are sufficiently interested in pathology to join the American Phytopathological Society. These facts are worthy of attention. Pathology is not only one division of botany, it is by far the largest division, it is a young division, it is growing very rapidly and must continue to grow rapidly in the future. As a result most pathologists are young, with the zeal and enthusiasm of youth and of expanding opportunity.

Another important fact to be noted is that pathologists constitute a remarkably homogeneous group as compared with the diversity amongst botanists. Plant diseases show almost infinite variety and the problems they present are equally varied. Yet whatever their previous training and experience, whatever the requirements of their particular problems, all pathologists speak the same language and think in the same terms. All recognize that they are working toward the same end on different phases of the great disease problem. Hence there has arisen a community of interest amongst pathologists unknown among botanists and impossible for them to develop. Pathologists are rapidly forming an esprit de corps which is an asset of the greatest value and will prove to be a powerful factor in future development.

The rapid growth of phytopathology in importance during the past few years has brought the pathologist more and more closely in touch with both producer and consumer of plant products. The world war has greatly increased his responsibilities in connection with the food supply. He has taken his place on the battle front of world action and more and more is losing the independence of the botanist as he

takes up the life of public service. He is drifting away from botanical fellowship, for circumstances have given him little time for mental adjustment, and for the throwing out of adequate anchors. So we have at the present time, this large and rapid growing body of botanical workers, remarkably homogeneous, with unusual esprit de corps, closely in touch with human life, which is drifting steadily away from the botanical standards and ideals of the past. Can either botanists or pathologists permit the drift to continue?

Pathologists are already losing much through lack of close association with other botanists. The demands upon pathologists have been many this past year on account of increased responsibilities, while their ranks have been depleted by the call of many of their number to military service. Teaching, laboratory research, field work, the ever-increasing demands of the extension service, all combine to give the harassed pathologist no respite. The future promises little hope for greater leisure because the world requires food. Although pathology is receiving increased financial support and additional helpers are rallying to her assistance, these additions barely keep pace with the ever mounting responsibilities. The pathologist must look forward to a life harassed by the multiplicity of problems insistently pressing for attention. Oftentimes he will be forced into print prematurely due to public and administrative requirements. Therefore, he must guard constantly against becoming hasty, superficial and narrow. He will need the broadening contact with the classical and fundamental work of other botanical fields. He will need the steadying influence of the greater leisure and consequent independence of the pure botanists. He will need their active assistance in the solution of his problems.

Botanists too have much to gain from close association with their pathological colleagues. Pathologists constitute the largest single group of botanists. They are virile and alert. They have the energy and spirit belonging to a young science. They possess the lofty ideals and contagious zeal of public service. They are in close touch with the throbbing pulse of human life and can furnish this valuable contact to other botanical workers. Botanists have watched the economic branches of their science develop one after another and slip away from their fellowship, while they themselves have stood by, either helpless or indifferent. This has gone on until many botanists now appear to regard applied botany as a thing apart, perhaps of a lower order, in which they may properly take only an academic interest. What an error! How can the virility of any subject be maintained except by human contact? Is not service the highest standard and the greatest activator? The value of any discovered truth is in the end determined by its usefulness, by its connection with other facts already known or yet to be discovered, and by its ultimate power for the uplifting of the world, physically, intellectually and morally. Scientific research for its own sake gives but a selfish joy, and may lead in the end to dry rot and to the scrap pile of human progress.

The progressive divergence of botanists and pathologists may well cause concern, but it has not yet become irremediable. The forces that make for dissociation can be overcome and closer union secured, but not by resolutions nor by legislation. There must be a general realization of the situation by both botanists and pathologists, followed by persistent effort at many points. I wish to suggest two important lines along which we should work.

In the first place, we should broaden our college courses in both botany and pathology. There has been extensive discussion in the English journals during the last few months on the botany to be taught after the war, and articles on the same subject are beginning to appear on this side of the water. It is urged that the teaching of botany should be broadened, that the elementary courses especially should not aim to instruct the student in botanical science, but rather to interest him in plants and in their manifold relations to his daily life. I shall not enter into this discussion except in so far as it concerns the subject before us.

I have listed the alma maters of 224 persons

actively engaged in pathological work, whose records were available. These persons are of various ages, are located in all parts of the United States, and the number is sufficiently large to be representative of the entire body of pathologists Of these 224 persons, 64, or 29 per cent., graduated at state agricultural colleges, 116, or 52 per cent., at universities which include colleges of agriculture, and 44, or 19 per cent., at colleges and universities without direct agricultural connections. I did not include in the above count those botanists who have been drafted into pathological service during the past few months on account of war conditions. These workers are of varied origin, are of all degrees of pathological training, and doubtless will largely resume their former positions with the return of normal educational conditions. Of the 44 pathologists listed as graduating at non-agricultural colleges and universities, over a third hail from a single institution, and a number of the remainder belong to the older group of pathologists who were trained as botanists, and entered the pathological field during the early period of its development. It appears then, that during the years preceding the war non-agricultural colleges and universities, excluding the single institution mentioned above, furnished less than 10 per cent. of the pathological workers of the United States. Is this a fair proportion? Why are so few graduates of our old-time colleges and universities entering the rapidly expanding field of plant pathology?

An examination of the curricula of these institutions is illuminating. Many of them offer no botany at all, or only elementary courses which are often labelled biology. Most of the institutions which possess departments of botany offer only standard courses in certain fundamental botanical topics and pay little if any attention to practical phases of the subject. Pathology as such is nearly, if not quite absent, and you can count on one hand with fingers to spare the institutions which give more than a passing consideration to mycology. Physiology, a subject of rapidly increasing importance to all branches of applied botany, fares only a little better than mycology. Botanical classes are usually small, graduate students few, and general interest in botany as a living subject undeveloped. The old botany of the schools and colleges is too narrow for the present day. Morphology and evolution are the backbone of most of these courses, and of nearly all text-books. But evolution needs no champion to-day, and botany taught from that standpoint alone does not appeal to American students. We need courses with a new method of attack, and text-books written from a new point of view. Botanical courses must be made more human. They must be squared with the progress and problems and life of to-day, even if this means radical revision of both methods and subject matter, and the surrender of some of the accepted standards which have served us indifferently well in the past. Fortunately there are all kinds of botanical subjects to interest all kinds of people, and with judicious selection elementary courses may be made to appeal to the many, rather than to the few. We must abandon the notion that the study of botany is a summum bonum, a choice privilege to be accorded only to the elect. The average student and the ordinary citizen must know botany, and must be aroused to an interest in plants as one of the most important elements of their environment. Only if this is done will the botany of the future achieve the importance it deserves. The responsibility for this vitalization rests largely on the undergraduate colleges. They must see to it that botany lives down its reputation of being an unimportant study for students who hope to become red-blooded men of affairs. They must not permit botany to be separated from the great field of agriculture which rightfully is hers. As well might chemistry withdraw from the industries, or mathematics deny mechanics and engineering. Botany has failed to qualify as an important subject during the emergency period of the war. Let us ask ourselves, is botany really unimportant to the nation at this time of emergency, or have botanists permitted it to appear so?

If now we turn to the curricula of the colleges of agriculture we find extensive courses

in pathology, in horticulture and in other branches of applied botany, but mycology, physiology and other fundamental botanical subjects too often receive inadequate attention. Specialization easily goes too far, and the product is a pathologist who is not also a botanist; he is a specialist with too narrow a training, with a foundation too restricted to permit the breadth of vision and the resourcefulness necessary for the adequate handling of many pathological problems.

Although these criticisms are not of universal application, I believe it is in general true that while the colleges on the one hand have been holding aloof and have not broadened their courses to include the modern applications of botany, the agricultural institutions on the other hand have specialized too strictly and have laid too little stress on the fundamentals of botany. Both tend to dwarf their students and practically restrict their graduates to their own fields, thus increasing the divergence between botanists and pathologists. In the future we shall need both botanists and pathologists. In addition, for the solution of many disease problems we shall need pathologists with a broad botanical foundation. These workers naturally should be trained by the colleges of agriculture. And we shall also need morphologists, physiologists, geneticists and ecologists with extensive knowledge of pathology, who naturally should be trained by the non-agricultural colleges and universities. When such a corps of workers is at hand, we shall not only have tremendously advanced both pathology and botany, but we shall have obliterated all distinction between the two subjects and made segregation into two groups of workers impossible.

A second vital force to draw together pathologists and botanists is cooperation in research work. The study of any plant disease is many sided, involving not only the study of the parasite and its effects upon and relation to the host, but the study of the host itself and of its varied relations to its environment, both in health and in disease. Not all pathologists are equipped to undertake certain of these problems which call for special training. Moreover, most pathologists, with manifold demands upon their time, are able to give attention only to the more immediately pressing features of the many problems before them. Hence their research work is perforce fragmentary and few diseases receive full consideration in all their phases. This procedure is faulty both from the scientific point of view, and in the end from the economic point of view as well, but it is made necessary by the pressure on the time of the pathologists and by restrictions on the use of public funds. The field of plant pathology is full of problems, morphological, cytological, physiological, ecological, genetical, which should receive attention, but whose solution is not in sight unless our botanical colleagues come to the rescue.

Many botanists in the colleges and universities could profitably take up this work. In choosing their research problems botanists have left the pathological field entirely to pathologists. In their desire not to encroach on the pathologists' domain they have avoided economic host plants to a large extent, and have turned away from cultivated fields and sought their material in woods and swamps. It is quite possible that by so doing they are sometimes passing by the material best suited to their purposes. Why should not geneticists breed economic plants more extensively and while determining the laws of inheritance, also produce improved strains of food plants? Why should not anatomists, cytologists, physiologists and ecologists study the potato or the cotton plant in health and in disease, and while conducting researches of fundamental scientific importance, be making needed contributions in the pathological field? Many of these pathological problems are suitable for master's and doctor's theses, and the fact that the problem has an economic flavor will, in the case of many students, give added zest to their work.

During the past year the pathologists, under the leadership of the War Emergency Board of the American Phytopathological Society, have inaugurated cooperation in research work to a degree which had been deemed impossible, so that the movement has attracted the attention of other scientific men. The pathologists

now propose to carry the get-together enthusiasm of the war over into peace times, to continue to foster the spirit of cooperation and to increase pathological efficiency by coordination of effort where such action is possible and desirable. It is clear that such a movement can not be forced, but must be allowed to grow under tactful management. The Society has therefore appointed an Advisory Board of six members to continue and foster the work initiated by the War Emergency Board. Can not the cooperative movement be extended to include other botanical workers? There are doubtless many botanists in the colleges and universities, especially those more or less isolated from botanical centers, who would gladly participate in cooperative projects. The problems are many, and there is no question but that pathologists will welcome most heartily the assistance of their botanical colleagues. It is probable that in many cases cooperation can be inaugurated most readily by conferences between individuals, especially on the part of workers in the same or adjacent regions, as the contiguity will ensure common interest in local problems, and will facilitate exchange of material and of ideas, and comparison of results. The Advisory Board will be glad to assist whenever possible by providing opportunities for cooperation and by facilitating the arrangements.

Botanists and pathologists are excellent complements of one another. In their closer union lies strength for the upbuilding of our common science in the momentous days which lie immediately before us. Of all the great nations of the earth we have suffered least from the ravages of the world war. We have felt its stimulus, but escaped its devastation. Hence the world is looking to America for leadership in many lines, and botany is one of these. We have the opportunity. We have the men. Have we the spirit? And can we supply the leadership? German domination is for the moment gone, but it will surely reassert itself if we are inactive. We must examine the bases on which German dominance in the field of botany has rested, and supply those factors which we now lack. We must write texts, compendiums and monographs to replace the German works which we are now using, and which we must continue to use indefinitely unless we ourselves write better ones. We must disseminate knowledge of botany amongst the people that we may receive the support which will enable compendiums to be written and research to be developed properly in both pure and applied fields. We must broaden our teaching of botanical subjects that we may produce not merely specialists, but the broad gauge men of wide perspective who shall be our leaders. We must stand together as botanists all, whatever our special field of endeavor may chance to be. If we do these things, and we can do them if we will, America will assume the commanding position in world botany.

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THE ELEMENTARY COURSE IN ZOOLOGY—IS IT SATISFACTORY?

AMONG the problems presented to the National Research Council by the government was one conveyed in the request of the War Department for the preparation of outlines of courses adapted to the conditions of the proposed Students' Army Training Corps. Like other divisions, that of biology undertook the work assigned it and formulated a suggested course. This was not printed and distributed in time to come into use, so that this effort of the council was entirely abortive. Since, however, biology was one of the subjects listed by the War Department's Committee on Education and Special Training, elementary biological courses of an intensive character were given in many institutions. It was the desire of several divisions of the council to determine the value of the educational experiment presented by the unusual requirements of the government's program. But unfortunately the conditions of the experiment were so disturbed by delays in starting work, by the occurrence of the influenza epidemic, and finally by demobilization of the corps before the completion of the first term, that no estimate could be placed upon the value of the results obtained from the operation of the novel

courses thus introduced. This is the general opinion of those to whom a hasty request for information went.

Along with this condemnation of the Students' Army Training Corps fiasco, there were, however, many expressions of opinion relating to the elementary courses in botany and zoology, among which were a number showing a lively interest in new or modified elements of the course. So pronounced was the interest in the character of the primary biological courses thus displayed that the division of biology decided to extend the inquiry further and so other letters were sent out as opportunity offered. Owing to the difficulty of reaching all those interested by letter, it has finally seemed best to make public through SCIENCE a request for expression of opinion regarding the nature of the elementary course in zoology or biology.

The connection of such an investigation into the nature of the elementary courses to research, the main concern of the National Research Council, may not be entirely obvious to all. That a relation of a somewhat intimate nature does exist seemed indicated to the division of biology when its executive committee undertook a general survey of the field in laying plans for a reorganization of its work for times of peace. Unless there be students trained in zoology there is little chance of developing new investigators in the subject, and in this training the elementary course occupies a peculiarly significant and important place. It offers the first contact between student and subject and has much to do with the formation of future tastes and habits. It forms, moreover, the chief connection between the zoology department and the college as a whole, and offers the greatest opportunity for exerting the proper influence upon the school. There sems also to be general agreement that this course is the most difficult to plan and to execute.

Because of these facts, and for the reason that the research council has the broadest interest in the relation of science to human welfare, it seems very properly one of its concerns to discover the kinds of elementary courses in science best adapted to serve as the first step in the preparation of scientific investigators and as the means for exerting the strongest and best influence upon the general college student.

Unless it be assumed that any kind of elementary course is satisfactory there must be some forms of it best adapted to meet the common needs of college students. That such is the feeling of many teachers is evidenced by the numerous attempts to formulate standardized beginning courses. Most of these have failed in their prime object because of emphasis upon nonessentials, although they have served a good purpose in stimulating discussion. The lesson seems to be written clear that if any large good is to be served by reopening this discussion there must be consideration of broad principles and an avoidance of unessential details. It seems a matter of no great moment whether the amoeba is studied at the beginning or at the end of the course, or at all. The amount of time devoted to any one type is not of great general concern but is a point which must be decided according to circumstances. To what extent, however, are the determining conditions of the course common to all institutions and how much allowance must be made for local conditions? Are there fundamental elements of a broad introduction to biology which necessitates the use of both plant and animal material or may the subject be presented adequately using either alone?

After satisfactory conclusions have been reached with regard to the general principles which should guide the construction of the introductory course, there are of course numerous practical questions which have a large bearing upon the success of its operation. How much time should be given it? Should the application of the student be consecutive or interrupted? How much of lecture, laboratory, conference and quiz work should there be? What use should be made of drawing and modelling? Should the work be given in the form of problems? How many forms of animals should be studied, etc.?

In order to arrive at any valid conclusions

regarding the problem raised by this investigation it would seem most appropriate to consider it in the light of any other scientific problem and to apply to its solution the scientific method. There should be no place for prejudice or for inertia. A rigid determination of the facts is called for, as a basis for conclusions. Such generalities as "the course should give a broad introduction to the subject" or "the course should give a look in on the subject" or "the course should cover the ground" do not contribute much to a reasonable practise. Only a clear analysis of the conditions inherent in the subject, of its interdependence upon other subjects in the curriculum, of the character of students to be taught, and of the instructor's part can lead to conclusions of value.

There are, accordingly, certain fundamentals which seem to demand attention. The first of those is the purpose for which the course is given. Is it primarily concerned in presenting the content, aims, methods or applications of the subject? Or is it possible in one course to include all these equally? Again, what form of presentation is the course to have—is absorption, verification or discovery on the part of the student to be emphasized? In considering the character of the course it would seem necessary also to have in mind the reason for its inclusion in the college curriculum as one of a series of more or less required subjects. Does it find a place here because of a certain informational value which recommends it to every liberally educated man, or is there something peculiar or distinctive about its methods or viewpoint which is absent, or less well represented, in other types of subjects?

It is true that no subject stands alone and that it is therefore impossible to make a complete and satisfactory determination of a course without taking into consideration, not only its interrelations within the curriculum, but also the varied material circumstances of the institution in which it is given. These considerations should not however prevent the fullest analysis of the problem or delay unduly the execution of such steps as are practicable for the improvement of the work. The influence of a thoroughly scientific practise in one department of a college can not fail to manifest itself to some degree in others and might lead to a much needed survey of the whole problem of college instruction. From the statements so far received it is apparent that there is lacking among biologists any general agreement upon the nature of the elementary biological courses and upon the reasons for their inclusion in the preparation of the liberally educated man. Such a situation would seem to be hardly commendable for any subject, and especially not for biology which deals with materials and processes in which purpose is so evident. It is possibly due to this lack of definite purpose and practise that biological subjects do not occupy the place in the curriculum which the best interests of the college students would require.

If there can be a full expression of opinion on these questions, after careful consideration, it may be possible to arrive at some general conclusion that should guide the operation of elementary biological courses. In this event it would then be possible to decide upon practical details with much less trouble, and with more profit. It is hoped that there will be such a general interest in this subject that a consensus of opinion upon at least the major elements of theory and practise may be reached. In order partly to guide such a consideration there will be published a number of typical outlines of courses already received upon which criticisms are invited. These suggestions and any other discussions upon the subject of zoological courses may be addressed to

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National Research Council
WASHINGTON, D. C.

WALLACE CLEMENT WARE SABINE[1]

OUR colleague, Wallace Clement Ware Sabine, was born in Richwood, Ohio, June 13,

[1] Minute on the life and services of Professor Sabine placed upon the records of the Faculty of Arts and Sciences at the meeting of March 18, 1919.

1868. Four racial strains were joined in him, for each of his four names represents some family of his ancestors, one Scotch, one Dutch, one English, one French. The Sabines, of Huguenot stock, came to Ohio from New England in the early part of the nineteenth century. The Wares, his mother's family, of English Quaker antecedents, came there about the same time, probably from New Jersey. Of his father's father, John Fletcher Sabine, the son of a circuit preacher, we are told:

> He was of such gentle disposition that in manhood he renounced the stern faith of his father and came to believe that "all men would be saved." . . . He died at the age of eighty-nine, with mind as vigorous and clear as in youth, with a remarkably retentive memory. His wife was Euphemia Clement, a gentle, industrious, reliable woman. Hylas Sabine was their oldest son.

Of his mother's father, Jacob Reed Ware, it is written:

> He was one of the early, ardent abolitionists and lived on the most direct line from Southern slavery to freedom in Canada. . . . Untiring of body, alert of mind, and exceedingly strong of purpose he lived in perfect health, with such simple habits that at the age of ninety-eight, without disease, he fell asleep. J. R. Ware married Almira Wallace, a woman of force and uprightness. Anna Ware was their first daughter.

To those who knew Sabine well this brief family history is deeply significant. Gentleness, courtesy, rectitude, untiring energy, fixity of purpose that was like the polarity of a magnet, all these traits we found in him. It is interesting and impressive to see how the individualism and stern conscience that made his ancestors on the one side Protestants in France and on the other side Quakers in England found expression in him, under changed intellectual conditions. He was of the very stuff of which martyrs are made; in fact, he died a martyr to his sense of duty, but, with an austerity of morals and a capacity for devotion which none of his conspicuously religious forefathers could have surpassed, he held aloof, silently but absolutely, from all public profession of religious creed, and he took small part in religious observances.

As a child he was allowed to develop without forcing, but such was the natural vigor of his mind that he gained the degree of A.B. at Ohio State University at the age of eighteen. He is said not to have specialized in his college studies, but he had in Professor T. C. Mendenhall an inspiring teacher of physics, and his early interest in scientific matters is shown by the fact that he attended a meeting of the American Association for the Advancement of Science held in Philadelphia in 1884, when he was sixteen years old. On leaving Ohio State University in 1886 he came to Harvard as a graduate student in mathematics and physics, and he received the Harvard A.M. in 1888. From 1887 to 1889 he held a Morgan Fellowship, but in the latter year he became an assistant in physics. Rather early in his Harvard residence he was taken by Professor Trowbridge as partner in a photographic study of the oscillating electric discharge, and he showed a remarkable aptitude for work of this kind, requiring high experimental skill, yet he never became a candidate for the Ph.D. Absorption in the work of teaching prevented him for several years from engaging deeply in further work of research. He spent his energy and his talents in building up courses of laboratory work, designing and making apparatus for instruction and in every way practising with devotion the profession of a teacher. It is not too much to say that, for the fifteen years preceding his taking the duties of a deanship, he was the most effective member of the department of physics in giving inspiration and guidance to individual students of promise. This was due in part to his comparative youth, though none of the department were repellently old; in part to his sympathetic willingness to give help and to spend much time in giving help, though others were not lacking in this quality. It was perhaps due mainly to the fact that, while he was no more deeply versed than others in the profundities of physics and mathematics, he had a peculiarly clear vision for the right kind of experimental problem and for the best way of attacking it, and his students instinctively, it may be, perceived this.

For a long time he seemed to be content to remain in comparative obscurity, while directing others into paths of conspicuous achievement. He was made assistant professor of physics in 1895, after six years of teaching, in which he had published little or nothing descriptive of research. This was partly because he had a most severe standard for what a research paper should be: it should describe some piece of work so well done that no one would ever have to investigate this particular matter again. To this standard he held true, with the result that his published papers were remarkably few and remarkably significant.

One might have expected him, when he found time for research, to take up some problem in light, for that seemed to be his chief field of interest; but accident, and a sense of duty, turned him to a different quarter. The Fogg Art Museum, on its completion in 1897, proved to have an auditorium that was monumental in its acoustic badness, and President Eliot, who had formed a high opinion of Sabine's qualities, called upon him to find a remedy, as a practical service to the university. With this warrant for diverting some of his energy from teaching, Sabine entered upon an investigation which proved to be his most conspicuous scientific work. Though he was dealing with a new structure, he was attacking a practical problem as old as the institution of public buildings. It had never been solved before in any thorough-going manner. He did solve it, and he did this not by virtue of any extraordinary resources given by modern science. He did it in such a way as to show that it might have been done by a man like him centuries before. Not only did he cure the defect of the particular room that first engaged his attention; he went on with his study till he could tell in advance what the acoustic qualities of a projected auditorium would be; and his visible instruments in all this achievement were organ pipes, common fabrics and materials, and the unaided human ear.

Was it, then so easy and simple a thing to do? Did he merely happen to find the solution of a difficulty thousands of years old? No. He succeeded by reason of a combination of qualities, among which were unending patience and untiring energy. He must work in the small hours of the night, when other men had ceased from their noisy labors and when street-cars were infrequent; he must, for certain ends, work only in the summer, when windows could be kept open; in the early summer, before the crickets began their nightly din. He must work with the most scrupulous regard for conditions that to another might seem trivial. He once threw away the observations of months because he had failed to record the clothes he wore while at his work. Such was the difficulty of his undertaking, on the mere physical side, and such the rigor of his devotion to it. We say of such a man, It is a pity he died so young. If he had taken care of himself, had been regular in his meals and in his hours of sleep, he would have had a long as well as a useful life. Yes; but the things he undertook to do, and did do, can not be done by a man who must be regular at his meals and regular in his hours of sleep.

The establishment of a Graduate School of Applied Science, in place of the undergraduate Lawrence Scientific School which had existed at Harvard for a long time, was the result of a movement led by Sabine in 1906. It was doubtless his hope, from the start of his connection with this revolutionary action, to make the Harvard School of Applied Science one of the highest and best in the world; but concerning the wisdom of making it distinctively and only a graduate school, he was not altogether positive, in spite of the fact that the suggestion to make it such is attributed to him. In fact, the decision of the faculty to approve this policy was arrived at in a curiously casual way. Argument against it was made at a faculty meeting, and nobody seemed to be confidently in favor of it. Sabine told a colleague the next day that just before the vote was taken he tried to get the president's attention, to move a postponement of the question. He did not succeed, the vote was taken, and the policy was launched.

Sabine took the deanship of the Scientific School reluctantly, at the urgent request of

President Eliot, but he threw himself into the duties of the office with characteristic energy, devotion, and elevation of ideals. It was his ambition to make the school as good as any school of applied science anywhere, and he strove for that end.

Whether the history and fate of the school would have been notably different if it had included undergraduate programs of study, is, fortunately, a question we need not discuss. For it is now possible to undertake the experiment of building up at Harvard a school of applied science second to none in its higher reaches but standing on a base of directed undergraduate work done within Harvard walls. In this undertaking we can have no better ideals than those which Sabine's deanship kept always before us.

When this deanship ended, he returned gladly to the work of teaching and research, and but for the war he would probably have had before him a long career of growing usefulness and fame, and would have lived to a vigorous old age according to the habit of his ancestors. But from that fiery furnace into which other men were drawn by millions he could not hold himself back. He would have felt recreant if he had escaped unscathed. Going to France in 1916 with the intention of giving a course of lectures as exchange professor at the Sorbonne in the fall, he engaged during the summer in the work of conducting tuberculous patients from the French hospitals to Switzerland, an enterprise undertaken by the Rockefeller Foundation. Overworking in this, he was attacked during the fall by a disease which nearly ended his life and compelled the postponement of his Sorbonne lectures. When he was able to be moved, he went back to Switzerland, this time as a patient; but he gained strength studying French constantly meanwhile, and in the spring of 1917 gave his lectures, on achitectural acoustics, in Paris. These ended, he went through some months of extreme activity in the technical science service of the allied governments. Returning to America in the late fall, he went on with similar work in Washington, and elsewhere, coming to Cambridge for his lectures every week, eating and sleeping when and where he could, always too busy for the surgical operation which his physical condition demanded. He refused military rank, declaring, with that severity of judgment which sometimes verged upon intolerance, that the uniform should be worn only by those who were subject to the dangers and labors of the front. But he risked his life constantly, and at last fatally, in the service of the country and the university.

We have known in him a rare spirit, and we reverence his memory.

Edwin H. Hall,
C. N. Greenough,
P. W. Bridgeman,
Committee

SCIENTIFIC EVENTS

THE GASPÉ BIRD RESERVES

The Parliament of the Province of Quebec, in its present session, has passed a law creating, on very broad lines, the remaining lodges of water-fowl on the shores and the islands of the Gulf of St. Lawrence into one great Bird Reserve to be under the administrative control of the Minister of Fisheries. Three definite areas are embraced within this protective provision, all of which are within the county of Gaspé.

1. Percé Rock, the picturesque and brilliant Devonian Island which lies a few rods off the coast of Percé village. Its bird colony is constituted of the Herring Gull and the Crested Cormorant.

2. The east and north cliffs of Bonaventure Island which lies three miles out from Percé. Here is probably the largest surviving colony of the Gannet with its customary associates—the Kittiwake, Razor-billed Auk, Puffin, Guillemot and Murre. The law takes over the entire face of the high cliffs where the two colonies on this Island are located and also a belt of land ten feet back from the edge of the cliffs.

3. The celebrated but now somewhat depleted colony of the Bird Rock, northernmost of the Magdalen Islands, 124 miles out to sea from Percé, in the heart of the Gulf.

The provisions of the law are rigorous. No one shall take or molest the birds, nests or eggs, nor carry a gun or other hunting gear within a mile of the sites indicated, either by land or water, under severe penalty of fine or imprisonment; and if a boat is used in violation of this law it is liable to confiscation. The law is made so broad as to include all migratory game, non-game and insectivorous birds as specified under the international treaty for the protection of such birds.

The extraordinary character of this law now in force is that it affords protection to a class of water-fowl which are commonly regarded as having little to do with the economic interests of mankind, and it specifically takes cognizance of the fact that these creatures are entitled to protection because of their natural beauty, their scientific interest and the part that they play in the scheme of nature. There could be no better indication of the liberal and high-minded sentiment of the Province of Quebec than this enactment which was initiated in the Parliament by the Honorable Honoré Mercier, Minister of Fisheries, in response to the labors and urgent representations of those who have had the interests of these colonies at heart. The Province of Quebec has thus created one of the largest bird reserves in the western continent and has erected a monument which is greatly to the credit of its own high-minded sentiment.

JOHN M. CLARKE

REORGANIZATION OF FARM MANAGEMENT OFFICE

REORGANIZATION and expansion of the Office of Farm Management of the United States Department of Agriculture is recommended by the committee of farm management leaders and others appointed some time ago by Secretary Houston to study the work of farm management and outline projects for more extensive studies.

The committee is made up of the following economists and students of farm crops: H. C. Taylor, agricultural economics, University of Wisconsin; George F. Warren, farm management, Cornell University; Andrew Boss, agronomy and farm management, University of Minnesota; J. A. Foord, agriculture and farm management, Massachusetts Agricultural College; J. I. Falconer, rural economics, Ohio State University; R. L. Adams, farm management, University of California; G. I. Christie, assistant Secretary of Agriculture, and representatives of the Bureau of Crop Estimates, the Bureau of Markets and the Office of Farm Management of the Department of Agriculture.

The basic recommendation of the committee is that the office be expanded to include both farm management and farm economics and that it be established as a bureau under the name of Bureau of Farm Management and Farm Economics. This, the committee states, it recommends "in recognition of the work already accomplished in farm economics along with the investigational work in farm management and in view of the great need for still further studies of the farming business."

Practically all of the changes recommended are in the nature of expansion and improvement rather than of creation. The system recommended for studies in cost of production is much more comprehensive than that heretofore used. "We have reviewed the projects now under way," the committee says, "and wish to commend their continuance and development." Some projects, it is thought, should be continued under other names. Some that are related to agronomy and some to other subjects, says the committee, "should perhaps be transferred to some other bureau of the department, securing the information or data desired on these lines through cooperative relations rather than independent action." In the projects underway, a great deal of work has been found that, the committee thinks, could be more profitably included under the term "Farm economics."

The work of the bureau, in the opinion of the committee, should be grouped around the following projects: Cost of production, including financial records, enterprise records, complete cost records, price relations and basic unit factors; farm organization, including farm business analysis, farm practise, effective

use of labor and farm equipment; farm finance, including methods of financing, insurance and taxation; farm labor, including supply and movement, trend of population, living and housing problems, creating new productive enterprises for farm labor and standards of supervision and compensation for farm labor; agricultural history and geography, including trend of agricultural development, shifts of agricultural production, relation of American to foreign agriculture and supervision of the Atlas of Agriculture; land utilization, including land resources and utilization, land settlement and land ownership and tenancy; farm life studies, including cooperation and trend of cooperative movements as affecting the farmer's life and activities on the farm, agricultural relations to other industries, agriculture for industrial workers, conditions of farm life as affecting national welfare; extension work, including publications and illustrative material, farm management demonstrations, farm labor supply and other farm economics demonstrations.

CORPORATION CHEMISTRY

The Newark Technical School has been elevated to the rank of a collegiate institution and the recently appointed director, D. R. Hodgdon, has made plans for special courses in theoretical and industrial chemistry. This has been recognized as a very desirable step because of the predominance of chemical corporations and chemical industry in the state of New Jersey.

The director announces that Frederic Dannerth, has consented to deliver a course of thirty lectures on corporation chemistry during the coming college year. Dr. Dannerth is well known as advisory chemist to many of the leading corporations in the country. He was one of the first to conceive the idea of a system of laboratory management, and is the inventor of numerous processes for industrial works using rubber, resins, oils and plastics.

This new course is probably the first of its kind offered to students of chemistry in America and is a direct outcome of the chemical development in the country during the past five years. The aim will be to show the application of the principles of industrial chemistry to the problems of manufacturing corporations—both those which are now in operation and those which are contemplated by investors and banking corporations. The lectures and seminars will be conducted in such a manner as to be intelligible to heads of the departments for purchasing, manufacturing and selling, as well as by fourth-year men in chemistry. The course will cover: (1) a study of industrial surveys conducted by chemists for the purpose of developing sources of supply for raw materials (this includes animal, plant and mineral materials). (2) Surveys of the executive departments of purchasing, manufacturing and selling. (3) Surveys of the advisory departments of engineering, law and research. (4) Laboratory Management (design, equipment, organization and administration). (5) The Economic Office (organization of the information files, museum of materials and products, as well as the library). The purpose of the course is to prepare graduates in chemistry for the hard, practical problems which confront them when they take up industrial work and at the same time an opportunity will be afforded persons now in executive positions to study the translation of scientific knowledge into industrial development.

MEMORIAL PROFESSORSHIP TO DR. JAMES JACKSON PUTNAM, 1846-1918

It is hoped that there may be an endowment of the professorship of diseases of the nervous system in the Harvard Medical School in memory of Dr. James Jackson Putnam.

In the development of this increasingly important branch of medicine, Dr. Putnam was a pioneer in Boston and in the country at large, while he was widely recognized in Europe as a neurologist of distinction. He inaugurated the neurological clinic at the Massachusetts General Hospital in 1872, and through forty years of service was devoted to its interests, and to teaching in the Harvard Medical School. In 1893 he was appointed the first professor of diseases of the nervous system; the professorship was then, and has remained, without endowment.

It is believed that those who have known Dr. Putnam may like to join in endowing this professorship which should always bear his name, and which would fulfill his hope that neurological work of a high order might be developed at the Harvard Medical School. To all of us who knew Dr. Putnam it would also commemorate the devotion and the self-sacrificing work of his lifetime.

President Lowell sends the following letter:

HARVARD UNIVERSITY, CAMBRIDGE,
February 8, 1919

My dear Dr. Walcott,

The suggestion of founding a professorship of diseases of the nervous system in memory of Dr. James Jackson Putnam appeals to me deeply both on account of the value of such a professorship to the medical school, and on account of the deep affection I had for Dr. Putnam and of my reverent esteem for his character. The foundation ought to appeal strongly to all who recognize the ever-increasing suffering caused to our over-sensitized community by nervous ailments, and to all who knew Dr. Putnam as patient or as friend.

Very truly yours,
A. LAWRENCE LOWELL

It is hoped that $50,000 may be raised as endowment, of which more than half is already promised. A reply from any one who proposes to contribute is requested now, but payment, either by check or in Liberty Bonds, may be made any time before December 31, 1919.

H. P. WALCOTT,
CHARLES C. JACKSON,
EDWARD W. EMERSON,
EDWARD H. BRADFORD,
MOOREFIELD STOREY, *Treasurer*
735 EXCHANGE BUILDING, BOSTON

SCIENTIFIC NOTES AND NEWS

SIR WILLIAM CROOKES, the distinguished English chemist, died on April 4, in his eighty-seventh year.

DR. S. F. HARMER, keeper of the department of zoology since 1907, has been appointed to succeed Sir Lazarus Fletcher as director of the British Natural History Museum, South Kensington.

AT a meeting of the Société de Biologie held in Paris on January 25, Dr. Simon Flexner, director of the laboratories of the Rockefeller Institute for Medical Research, New York, was elected an associate member of that society.

THE Royal Geographical Society has awarded the Founder's Medal to Colonel E. M. Jack for his geographical work on the Western Front; the Patron's Medal to Professor W. M. Davis, of Harvard University, for his eminence in the development of physical geography; the Victoria Medal is awarded to Professor J. W. Gregory for his many and important contributions to geographical science; the Murchison grant to Dr. W. M. Strong, of the Northeastern District, Papua, for his journeys and surveys in New Guinea; the Cuthbert Peek grant to Professor Rudmose Brown for his geographical work in the Antarctic and in Spitsbergen; the Back grant to the Venerable Archdeacon Stuck, of Fort Yukon, for his travels in Alaska and ascent of Mount McKinley, and the Gill memorial to Mr. W. J. Harding King for his investigations of desert conditions in northern Africa.

THE Schwabacher prize of 20,000 marks was recently divided between Professors Rubner and Zuntz, both of Berlin, for their work on diet in war time.

DR. H. S. WASHINGTON, of the geophysical laboratory, Carnegie Institution, has been elected a foreign member of the Accademia dei Lincei.

PROFESSOR J. C. MERRIAM, of the University of California, has returned to Washington to act as chairman of the National Research Council.

DR. HERMANN M. BIGGS, state commissioner of health of New York, has been granted six weeks leave of absence and is now *en route* to France, where he will aid in the establishment of an international Red Cross society.

DR. T. WAYLAND VAUGHAN, accompanied by D. D. Condit, C. W. Cooke and C. P. Ross, have gone to the Dominican Republic, to make a preliminary inspection of the geology in preparation for a geological survey under the direction of the military government of the

republic. Lieutenant Colonel Glenn S. Smith is organizing a topographical survey.

C. K. Leith, professor of geology at the University of Wisconsin, has returned from Paris, where he served as mineral adviser in the economic section of the American Peace Commission. Prior to the Paris work, Professor Leith took an active part in mineral advisory work for the Shipping, War Industries and War Trade Boards, in Washington, particularly in relation to restrictions and regulation of international trade. Professor Leith has now left government service to resume his work at Madison.

Major Wm. Lloyd Evans, C.W.S., who was the head of the laboratory and infection division, Edgewood Arsenal, has resumed his duties with the department of chemistry of the Ohio State University, having been discharged from the U. S. Army. On March 6 Major Evans gave a public lecture under the auspices of the Ohio State University Chapter of Sigma Xi on "America's answer to German gas warfare."

Captain Paul Popenoe, San. C., director of the section on vice and liquor control, Commission on Training Camp Activities, was discharged from military service on April 2. Mr. Popenoe, who was formerly editor of the *Journal of Heredity,* is organizing a department of law enforcement for the American Social Hygiene Association, New York City.

Mr. Robert L. Moore, of the Bureau of Standards, has been transferred to the rubber laboratory of the bureau at the University of Akron, Akron, Ohio.

Dr. Albert M. Reese, professor of zoology in West Virginia University, will leave the last of April for British Guiana, where he will spend the summer at the Tropical Research Laboratory of the New York Zoological Society. During his absence the work of the department will be in charge of Dr. Harrison H. Hunt, assistant professor of zoology.

Mr. W. M. Smart, of Trinity College, has been appointed chief assistant at the observatory of the University of Cambridge.

Dr. T. A. Henry, late superintendent of the laboratories at the Imperial Institute, London, has been appointed director of the Wellcome Chemical Research Laboratories, London. Dr. F. L. Pyman, the former director of these laboratories, has accepted the professorship of technological chemistry in the Manchester Municipal College of Technology, and in the University of Manchester.

Dr. Addison, president of the British local government board, has appointed Miss Janet Mary Campbell, M.D., M.S., to be a medical officer of the board in special charge of the work of the board in respect of maternity and child welfare.

Mr. J. O. Lewis, superintendent of the petroleum experiment station at Bartlesville, Oklahoma, has been appointed chief petroleum technologist of the Bureau of Mines, to succeed Mr. Chester Naramore, who has resigned from the bureau to join the Union Petroleum Company, at Philadelphia, Pa.

The United States Interdepartmental Social Hygiene Board announces the following appropriations from the Scientific Research Fund of the board: Leland Stanford Junior University Medical School: (1) Investigation into more effective treatment in acute and chronic gonorrhea, under the direction of Dr. R. L. Rigdon, clinical professor of genito-urinary surgery, and Dr. Alfred B. Spalding, professor of obstetrics and gynecology, San Francisco, $2,300. (2) The permeability of the meninges to antisyphilitic drugs—an attempt to increase their permeability, under the direction of Dr. Henry G. Mehrtens, clinical professor of neurology, San Francisco, $2,300. (3) Investigation into more effective methods of treating syphilis, under the direction of Dr. Harry E. Alderson, clinical professor of dermatology, $2,600; total, $7,200. University of Michigan, College of Medicine and Surgery: (1) A research for an improved method of demonstrating *Spirochæta pallida* in human tissues, under the direction of Dr. Alfred S. Warthin, professor of pathology, Ann Arbor, $6,000.

DR. ALEŠ HRDLIČKA will deliver during the months of April and May a series of four lectures at the medical college of the Georgetown University, on "The relations of anthropology to medicine."

THE reconstruction lectures given Saturday evenings at Yale University last term during January, February and March were resumed on April 5 and will continue through May 17. The complete schedule of the remaining lectures is as follows:

April 5. Dean Charles R. Brown, "Reconstruction and the churches."

April 12. Professor Lester P. Breckenridge, "Reconstruction and engineering."

April 19. Dean George Blumer, "Reconstruction and the medical profession."

April 26. Professor C.-E. A. Winslow, "Reconstruction and public health."

May 3. Director Russell H. Chittenden, "Reconstruction and science."

May 10. Dean Thomas W. Swan, "Reconstruction and the legal profession."

May 17. Professor Irving Fisher, "Reconstruction and the price level."

THE Cutter lectures on preventive medicine given annually under the terms of a bequest from John Clarence Cutter, were given at the Harvard Medical School on March 17 by Harry E. Mock, M.D., Lientenant Colonel, M.C., U.S.A., Division of Reconstruction of Disabled Soldiers War Department, Washington, D. C., on "Industrial medicine considered from an economic viewpoint," followed by "Reclaiming the disabled," illustrated by motion pictures, and on April 2, 3 and 4 by Alice Hamilton, M.D., special investigator of the U. S. Department of Labor, Chicago, Illinois, on "Industrial poisoning in the United States." The subjects of the three lectures were: (1) "Lead"; (2) "Other organic poisons"; (3) "Poisons of the aromatic series and of the fatty series."

UNIVERSITY AND EDUCATIONAL NEWS

AN alumni memorial to honor Dr. C. R. Van Hise, late president of the University of Wisconsin, has been proposed in the form of a Van Hise Memorial Geological Building to be erected on the campus to bring together under one roof the departments of geology and mining engineering, as well as the state and national geological surveys.

Two gifts to the Harvard Medical School have been received recently. One is an anonymous donation of $50,000 for the establishment of the James C. Melvin Fund for Tropical Medicine. The income is to be used for research in preventive medicine. The other is the residuary bequest of Horace Fletcher, who established a wide popular reputation as a dietitian. The income is to be used to "foster knowledge of healthful nutrition."

SCOVILL PARK, embracing several acres of land lying next to the property of the University of Kentucky in Lexington, Kentucky, has been donated to the university by the city. The land is given without condition except that it be made available to the city for playground purposes until the university is ready to build on it.

PROFESSOR CARLTON I. LAMBERT, F.R.A.S., an old scholar of the City of London School, has given £1,000 with which to found a scholarship for applied science at the school.

NEW YORK UNIVERSITY and Bellevue Hospital Medical College will admit women on the same basis as men and with full privileges of the college, in September.

DR. HORACE D. ARNOLD has resigned as director of the graduate school of medicine of Harvard University.

DR. VICTOR ZIEGLER, professor of geology and mineralogy and head of the department at the Colorado School of Mines, has resigned this position.

DR. C. C. FORSAITH, who has been instructor in the department of wood technology at the New York State College of Forestry, at Syracuse University, for the past year and a half, has been appointed assistant professor of wood technology in the same institution.

Dr. George Barger has been appointed to the chair of chemistry in connection with medicine at Edinburgh University. Dr. Barger is at present research chemist to the Medical Research Committee, National Health Insurance.

At the University of Cambridge Mr. Joseph Barcoft, F.R.S., of King's College, has been appointed reader in physiology; Mr. A. V. Hill, F.R.S., of King's College, university lecturer in physiology, and Dr. Hartridge, of Kings College, university lecturer in the physiology of the senses.

DISCUSSION AND CORRESPONDENCE

PATENT REFORM PROSPECTS

A *Report of the Patent Committee* of the National Research Council, recommending *inter alia,* (1) the separation of the Patent Office from the Department of the Interior, (2) the creation of a single Court of Patent Appeals, to be located in Washington, and (3) certain salary readjustments, is being printed in the March issue of the *Journal of the Patent Office Society*—of which additional contents are as follows: "The Patent Office from 1828 to 1836" (a historical article), by W. J. Wyman; "A United States Patent Commission" (preferring a commission to a commissioner), by John Boyle; "A Proposed Reorganization of the Examining Corps" (advocating the grouping of related divisions into "departments," to be supervised by the respective members of a strengthened board), by Bert Russell; "Art Classification of Patents for Patent Office Use" (favoring reliance on analogies of structure and function), by G. A. Lovett.

It is understood that the matters referred to in the above-mentioned report are but initial measures and that the Patent Committee has been continued, to press for necessary legislation.

At a meeting of the Patent Office Society on February 17, the following resolution was taken with reference to the proposed separation: That the Patent Office Society approve, and support by all proper means, both as an organization and as individuals, that National Research Council bill which provides for the establishment of the Patent Office as a separate institution, independent of the Interior Department and of every other existing department of the government. The discussion of the foregoing resolution included no single word of disesteem toward Secretary Lane, under whose jurisdiction the office now is.

Dr. Geo. E. Hale, chairman of the Council, in an address to the Patent Office Society on March 3, 1919, stated the present personnel of the council's enlarged Advisory Committee on Industrial Research, including many well-known leaders in the industrial world. Dr. Hale deprecated the impracticable distinction between "pure" and "applied" science, and emphasized again, even in connection with industrial advance, the importance of what he preferred to call the fundamental sciences.

Because Dr. Hale had also stressed the importance of those cross connections for which the Research Council aims to provide, associating the various groups of specialists now at work in diversified and somewhat isolated fields, and because of the prospect of a continued activity on the part of the Patent Committee as above referred to, this latest announcement was construed by Dr. Hale's hearers as justifying the hope of some very real and general cooperative effort toward the establishment of a patent system that shall in fact do its proper part—nationally and perhaps internationally—"to promote the progress of science and the useful arts."

Bert Russell

A STANDARD SCIENTIFIC ALPHABET

To the Editor of Science: May I call the attention of Mr. J. C. Ruppenthal whose letter on, "A Standard Scientific Alphabet" appeared in Science for February 21, 1919, pp. 191–192, to the International Phonetic Association.

Its secretary, just before the war, was Paul Passy, its address, 20 rue de la Madeleine, Bourg La-Reine, Seine, France; its organ, *Le Maître Phonétique.* It had about 1,800 members and it has adopted an International alphabet which can be used for all languages

and is widely employed by phoneticians. The work of Mr. A. G. Bell and the late Mr. H. Sweet should also be referred to in this connection.

Of perhaps greater importance than a standard alphabet is the question of an international language. In this connection the "Academia pro Interlingua" has carried on a scientific study of the question and perhaps the majority of its members are in favor of adopting simplified Latin. Professor G. Peano, of the Turin (Italy) University, is president of the Academia which has been in existence over twenty-five years.

A. FANTI

BUREAU OF STANDARDS

DR. MOODIE'S OPISTHOTONUS

TO THE EDITOR OF SCIENCE: Professor Moodie's Study No. 3, Paleopathology, "*Opisthotonus* and Allied Phenomena among Fossil Vertebrates,"[1] aims to show that the bent back head which one sees not commonly in well preserved vertebrates is "a manifestation of spastic distress" of the creature, "suggesting a strong neurotoxic condition," and leading the author even to seek for the infecting bacteria which have given the shortly-to-be-fossilized vertebrate a cramp in the neck. This condition Dr. Moodie compares with opisthotonus in man as illustrated in Bell's painful drawing.

I wonder, nevertheless, whether it is necessary to seek so far afield for the cause of this head-bent-back position in fossils. This position, every one will admit, is an extremely common one, in fact most backboned animals show it when they are well preserved—while opisthotonus is, so far as I know, an extremely rare malady. It would trouble one to find recorded cases of it in reptiles or birds, amphibia or fishes: even in mammals collectively the percentage of deaths following opisthotonus would evidently be microscopically small. Then, too, when one of these rare cases died in cramp would it be apt long to retain that position while it floated down a stream with muscles rotting, or while it dried out of its soddenness on a bank of mud, or while deliquescently putrid it became picked more or less to pieces by all manner of sarcophagous creatures? No it seems to me that what the doctor calls "opisthotonus" is merely a physical phenomenon which causes the neck region of a macerating vertebral column to bend backward. For on the back of the column are stouter ligaments which hold the bones together: hence when the backbone eventually loosens up in the process of decomposition the bodies of the vertebræ separate earlier than the arches, thus producing the inbent column. Of course there would be no great degree of bending back in the chest region, for here the cage of ribs would long keep the back straight: nor in the lumbar region, since here the neural arches are short and there is therefore less leverage for their dorsal ligaments: nor again in the tail, for here the ligaments are far more nearly balanced in all sides of the column.

BASHFORD DEAN

COLUMBIA UNIVERSITY

FIELD WORK IN ARIZONA

TO THE EDITOR OF SCIENCE: At the last faculty meeting of the University of Arizona, President R. B. von Kleinsmid outlined a plan for summer-session work that was received with enthusiasm by the faculty, and may be of interest to many readers of SCIENCE. Since the climate of Tucson is not suited to the conventional campus summer-session, the university plans to carry on vacation-work in the field, in several parts of the state where the climate is more bracing or where the work would be of such a character as to make the mid-summer heat a negligible consideration. It is proposed that groups of students under the direction and leadership of professors from the University of Arizona, study: archeology through actual excavation work in the northern part of the state, geology at the Grand Canyon, biology at the Mt. Lemon camp, mining engineering at the great copper mines, etc. Such opportunities for first-hand observation and investigation in an interesting and comparatively fresh field will doubtless appeal

[1] *Am. Naturalist*, LII., pp. 369–394.

to many teachers of science throughout the country.

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QUOTATIONS

SCIENCE IN THE BRITISH PARLIAMENT

Among the 707 members of the new parliament there are two fellows of the Royal Society, that is to say, of the body which contains the leading representatives of scientific knowledge and research. One of these, Mr. Balfour, must be taken as an example of the smaller number of fellows who are elected because of their social position and general culture rather than of the normal body of fellows elected because of their devotion to and distinction in scientific research. Sir Joseph Larmor, the other fellow, is a typical example of high scientific distinction, and it is merely an individual accident that his parliamentary record is one of blameless devotion to party politics rather than of specific representation of science. Curiously enough, there are two former teachers of human anatomy—Dr. Addison and Sir Auckland Geddes—and Mr. Mackinder was a well-known geographer before he became a politician. The great experience of Sir Philip Magnus has been in the directorate of institutions for applied science and technology rather than in actual scientific pursuits, and a similar comment may be made on Mr. Woolcock's relation to pharmacology and drugs.

The new parliament will be charged with the duty of reconstructing the social, commercial and industrial fabric of the country and of the empire, and among its 707 members there is only one whose life has been devoted to scientific research. Let it be said at once that the object of calling attention to this defect in the House of Commons is not to advocate the presence in parliament of scientific representatives who should try to protect the interests of scientific men in the fashion in which the representatives of professional and working-class trade unions foster the material interests of their members. The point which ought to be taken is wider, and concerns not a group of individuals, but the whole nation. Huxley, in an address delivered to workingmen in 1868, stated the case in words of enduring cogency. After saying that any one would be a fool who should sit down to a game of chess on the winning or losing of which depended his life and fortune without knowing something of the rules of the game, he went on to say:

> Yet it is a very plain and elementary truth, that the life, the fortune and the happiness of every one of us do depend upon our knowing something of the rules of a game infinitely more difficult and complicated than chess. It is a game which has been played for untold ages, every man and woman of us being one of two players in a game of his or her own. The chessboard is the world, the pieces are the phenomena of the universe, the rules of the game are what we call the laws of nature. The player on the other side is hidden from us. We know that his play is always fair, just and patient. But also we know, to our cost, that he never overlooks a mistake, or makes the smallest allowance for ignorance. To the man who plays well, the highest stakes are paid, with that sort of overflowing generosity with which the strong shows delight in strength, and one who plays ill is checkmated—without haste, but without remorse.

In the complicated conditions of modern life, very few of us can play our own game. In sanitation, housing, public health, provision for research, relation of general research to specific inquiries, and a multitude of other matters of fundamental importance, we have to leave all the important moves to parliament. Neither in parliament nor in the departments from which most of the initiation comes, and on which all the execution will depend, is there a sufficient leaven of the requisite knowledge.

It will be said that expert advice is always taken on scientific matters. Assuming this, and adding to it the further assumption that the advice is always acted on with intelligence and sympathy, it is to be noted that expert advice is also always taken on financial matters, commercial matters, legal matters and so forth, and that, none the less, there are in the House of Commons very many members with expert knowledge of, and interest in, finance business, and law. These are ready and able to suggest the final criticisms, adjustments and coordinations that may be required in the measures

that are proposed. There is not this opportunity in science, although science is fundamental.

The relative absence of scientific men from the House of Commons is both a cause and a symptom of the neglect of science in this country. The majority of members of parliament fall into two classes. One of these consists chiefly of representatives of the great working-class organizations, whose subscriptions supply the necessary funds for contesting elections, and whose membership gives the requisite electoral backing. Even if a similar combination were to be desired in the case of scientific workers—an extremely doubtful proposition—their numbers are too few to make it effective. The other great class consists chiefly of persons who have inherited or acquired a competence, and who have the money and the leisure to woo an electorate. As matters are arranged at present, it is almost impossible for a man who devotes his life to scientific research to acquire a competence. His life is spent between the laboratory and the lecture-room amid gray suburban or provincial surroundings, with possibly a small retiring pension. He must be content, and for the most part he is content, with the high adventures of thought and with the appreciation of his fellows. We suggest that this compulsory segregation is bad for scientific researchers and worse for the nation.—*London Times.*

SCIENTIFIC BOOKS

Contributions to Embryology. Published by the Carnegie Institution of Washington. No. 1, 1915; No. 26, 1918. Volumes 1–8.

Every Amercan embryologist who does not indulge in envy may pardonably take pride in the *Contributions to Embryology* issued by the Carnegie Institution. They form an anatomical publication of unqualified distinction, since all three factors needed for success have fortunately been realized. First, there has been a group of able contributors with beautifully illustrated and important manuscripts; further, there has been generous means for the proper publication of whatever is accepted. Finally, there has been an editor in charge, whose name does not appear in the title, but whose impress is upon every page. It is not by chance that the great journals of anatomy have been edited by no less distinguished leaders than Max Schultze, His and Virchow. The Carnegie Contributions which thus far rank so well with these are essentially *Mall's Archiv* and one of his worthiest memorials. Even though they are being so ably continued by his junior colleague in the Carnegie Laboratory, who may realize all that Mall had planned, we can not repress deep regret that the work was only well established—scarcely more than begun—when it was left for others to carry on.

Why is the publication so attractive? Possibly because of the absence of "efficiency" methods, so incompatible with scholarly and artistic work. The contributions even appear at irregular intervals when something of moment has been completed and not because it is time for a new issue. There are no rules for preparing standard manuscript, no Procrustean regulation that for every plate there must be so many pages of text, and thanks to the Carnegie Institution, no insulting request that authors of accepted articles pay any part of the cost of publication. If the editor finds a contribution unworthy of a place, he may decline it; but if accepted, it will be fittingly published with the needed figures skilfully and delicately reproduced. And because the editor's judgment is sound, it becomes an achievement to have an article appear in such select company. Probably the *Contributions* shed their enlightening rays in the far corners of the earth, but it is not so announced. The contributor, however, knows for himself that wherever human embryology is studied, these publications will be sought for and treasured.

The series of twenty-six papers thus far published begins auspiciously with Mall's monograph on the fate of the embryo in tubal pregnancy, and Professor Mall has contributed two others—on cyclopia and on the intrachorionic magma. Professors Van der Stricht and Duesberg, who, during the occupation of Belgium, became the welcome guests of American anatomists, continued here their well-

known investigations. Van der Stricht has written on the genesis and structure of the membrana tectoria and crista spiralis of the cochlea, and Duesberg on "la fécondation des ascidiens"—a study of chondriosomes. Cowdry likewise has dealt with the mitochondrial constituents of protoplasm and has supplied a shorter paper on the chromophile cells of the nervous system. Mitochondria in nerve cells are quantitatively considered by Madge D. Thurlow. The transitory cavities in the corpus striatum are described by Essick. Two papers deal with tissue cultures, the occurrence of binucleate cells being described by Macklin, and the development of connective tissue fibers by Margaret R. Lewis. Miss Sabin, through series of fine injections, strikingly reproduced, has traced the transformation of the posterior cardinal veins of pig embryos, and, in a second paper, the origin of the primitive vessels in the chick. Streeter has advanced the study of the cerebral sinuses, which have been beautifully drawn, and has described also the formation and spread of the periotic tissue spaces. Weed's important work on the development of the cerebrospinal spaces forms the whole of Volume 5. Clark interprets an extraordinary anomaly of the thoracic duct, and Cunningham describes the pulmonary lymphatic vessels of pig embryos. There are three monographic studies of normal human embryos, by Ingalls, Johnson and Watt; and a specimen with spina bifida is described by Miss Wheeler. Corner reports on the corpus luteum in the pig. Meyer has a statistical study of prenatal growth, based on obstetrical records, and Shipley and Wislocki jointly, interested in the chemical products of the poison glands of *Bufo agua,* a tropical toad, describe the histology of these epinephrin-producing glands. In the twenty-sixth and last contribution, Kunitomo deals with the retrogression of the caudal end of the spinal cord and the decline of the tail in human embryos.

The contributions are irregularly grouped in small volumes which are sold separately. Doubtless it would be appreciated if a limited number of the separate articles were offered to embryologists, though every institution needs the complete file. Altogether it is a journal to be studied by those responsible for our anatomical publications. When the *American Journal of Anatomy* was founded and was being published in Baltimore largely under Mall's direction, it seemed that nothing better was likely to appear in this country. But as the *Journal* became securely established, losing —perhaps we imagine it—the enthusiasm of the earlier volumes, Mall's genius for publications sought new fields. His *Contributions* have caught in beautiful form and permanent record the spirit and purposes of current American investigations in embryology, and their future is full of promise.

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SPECIAL ARTICLES

NOTE ON THE TECHNIQUE OF SOLUTION CULTURE EXPERIMENTS WITH PLANTS

In recent years a large number of sand and solution culture experiments have been carried out by various laboratories. It is becoming recognized that any complete understanding of soil fertility requires an insight into the absorption and metabolism of the plant as well as the nature of the soil solution. In connection with some investigations relating to the latter question, this laboratory has undertaken a series of studies on the effect of concentration and reaction of the nutrient solution on the growth and absorption of the barley plant. Incidental to this work it has been necessary to examine somewhat critically several phases of the technique employed in sand and solution cultures, and it is desired to present here a number of considerations bearing on the interpretation of these experiments.

Ordinarily the conclusions from such investigations have been based on the concentrations and composition of the solutions as originally prepared. In very few cases have analyses been made of the solutions after contact with the plant, nor of the plants themselves. It is not known therefore exactly what was the condition of the solution during the periods between changes. The percentage

variation in the solution for any given element will depend upon the total quantity absorbed, upon the concentration in the original solution, and also upon the volume of solution provided per plant. It is essential to differentiate between two sets of factors, the composition and concentration of the solution and the total quantities of the various elements present. The effect on the plant might be the result either of the concentration as found in the original solution, or of an insufficient total supply of one or more elements. In order to study the effects of concentration or of composition on plant growth, ideally a continuous flow of solution should be arranged so that the roots are always bathed in a solution of constant composition. Such a technique is ordinarily impracticable, and it is necessary to approximate the desired condition by providing a sufficient volume of solution per plant and by frequent changes. This is particularly true when the object of the investigation is to determine the relative effects of a series of solutions. To give a specific example, certain solutions may have only one tenth of their total concentration due to $Ca(NO_3)_2$. In such a case it is possible that all of the NO_3 might be absorbed before the solution was changed, or at least reduced to a very low level of concentration. Thus, if the interpretation of the experiment is based on three salt triangular diagrams, the effect, actually the result of insufficient NO_3, might be correlated with a certain calcium magnesium ratio.

In some experiments small bottles (250 to 400 c.c.) have been used with three to six plants in each bottle, changes of solution being made every three days, or sometimes only every four or five days. In the sand culture series the size of the jars usually permits the use of only 250 to 400 c.c. of solution per jar. In our experiments (to be described elsewhere) from 500 to 2,200 c.c. of solution per plant (barley) have been used, with changes every two or three days in many cases. Actual determinations of the absorption of each element have been made by analyzing the solutions or the plants. It has been found that under favorable conditions of light and temperature, more than 30 per cent. of the total electrolytes may be absorbed in three days, when 500 c.c. of a favorable nutrient solution of 2,500 p.p.m. concentration is provided for each plant. All of the elements are not absorbed in equal percentages, consequently not only the concentration but also the relation between the elements has been altered. In one experiment with solutions containing 100 p.p.m. NO_3 (500 c.c. solution per plant) barley plants six weeks old absorbed every trace of NO_3 from the solution in less than 72 hours.

In several experiments in which plants have been grown in solution and sand cultures the yields of straw and heads are fairly comparable with those of plants produced in the field, where an excellent crop is obtained. In some sand and solution culture experiments reported the yield per plant has evidently been much inferior to that for similar plants grown in the soil for an equal period. Some limitation of light, temperature, aeration or of the nutrient solution must therefore have existed. In many cases there is a strong presumption that the supply of nutrients may have been deficient, as noted above.

We do not desire, however to criticize any specific investigations. If plants are grown under sub-optimal light or temperature conditions, the total quantities of nutrients absorbed per plant may be much less than in our experiments. Moreover, in the first few weeks the plant has not reached its maximum power of absorption, so that short culture periods will require less quantities of nutrients. The point we desire to emphasize is that plants grown under the most favorable conditions may absorb or require much larger quantities of nutrients per plant than are ordinarily provided in sand and solution culture work. Each set of conditions should be tested by actual analysis of solutions and plants and results interpreted in terms not of the original solution alone, but also in terms of total supply and the varying condition of the solution in the periods between changes. It should also be noted that deficiencies in total

supply in the earlier stages of growth may stunt the plant so that absorption in the later stages is much less than would occur with a normal plant.

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UNHEATED EGG-YOLK MEDIA

For some years the writer has been using unheated egg-yolk media and has found them especially valuable in studying one of the foulbroods caused by an organism (*Bacillus larvæ*) which offers considerable difficulty in its cultivation. In a paper "Further Studies on American Foulbrood" to be published in the *Journal of Agricultural Research* reference is made to the employment of such media successfully in the study of this species. Believing that the fact might be of interest to those studying diseases caused by organisms for the cultivation of which unheated animal products are being employed and possibly also to those using heated egg media in their work, the technic used in the preparation of these media is given at this time.

These are prepared by adding simply a sterile aqueous suspension of egg-yolk to the different media commonly used in the laboratory. The egg suspension is obtained as follows: After being disinfected the shell of the egg is broken the white poured off and the yolk dropped into a flask containing about 70 c.c. of sterile water. By agitating the flask a uniform suspension of the yolk material is obtained. This is then transferred to sterile tubes by pipetting, and stored until needed. On standing the suspension separates into a more or less translucent supernatant fluid and an opaque lighter yellow-colored sediment.

In preparing the egg media about 1 c.c. of the egg-yolk suspension is added to each 5 c.c. of the base medium. If only the supernatant fluid is used a clearer medium will result. Egg agar has been the most useful of these media in the work referred to. The base should be at least 1.5 per cent. agar and after being liquefied should be cooled to between 45° and 50° C. before the suspension is added. Tubes may be inclined and stored until needed. The medium may be inoculated and plates made, or sterile plates may be poured. Although the pipetting of the sterile suspension rarely results in contamination of the media, if convenient to do so, it is well to test them for sterility after this step is taken. The egg suspension itself is a medium of some differential value.

Eggs known to be recently produced are preferable for the egg-yolk suspension, although those obtained from the market labelled "strictly fresh" have usually been satisfactory. The shell is disinfected conveniently by immersing the egg in a suitable solution for a few minutes. A 1: 1,000 mercuric chloride one is satisfactory for the purpose. Alcohol and solutions of carbolic acid and formalin have been used but the latter two unless gloves are employed are unpleasant to the hands. After removing the egg from the solution, the shell is broken about one end and removed with forceps sterilized conveniently in the direct flame. The white being poured off the limiting membrane of the yolk is broken and the yolk material is poured into the flask containing the sterile water. The degree of transparency of the supernatant fluid depends somewhat upon the amount of water used in making the suspension. Occasionally contaminations are encountered. These are usually detected by changes in the appearance of the suspension following incubation.

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SCIENCE

A Weekly Journal devoted to the Advancement of Science, publishing the official notices and proceedings of the American Association for the Advancement of Science

Published every Friday by

THE SCIENCE PRESS

LANCASTER, PA. GARRISON, N. Y.
NEW YORK, N. Y.

Entered in the post-office at Lancaster, Pa., as second class matter